Omar Alhussein

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Education

Jan2016 - Apr2020 **PhD in Electrical Engineering (Communications and Information Systems)**,
University of Waterloo, ON, Canada
Thesis: On the Orchestration and Provisioning of NFV-enabled Multicast Services
Advised by: Weihua Zhuang

May2014 - Aug2015 **MASc in Engineering Science**,
Simon Fraser University, BC, Canada
Thesis: Performance Analysis of Wireless Fading Channels: A Unified Approach
Advised by: Jie Liang and Sami Muhaidat

Sep2008 - Aug2013 **BSc in Telecommunication Engineering**,
Khalifa University, Abu Dhabi, United Arab Emirates

Research Interests

Networking, Machine Learning, Wireless Communications, & Optimization

Research Experience

Jun2020 - present **Senior Research Engineer**, *Huawei Technologies Canada*, Ottawa, Canada
- Working with the advanced networking team.
- Researching native machine learning-based solutions for next-generation networks.
- Collaborating with academic teams on research projects.
- Submitted three patents on AI trustworthiness and probabilistic and distributed AI for networking, with others in the pipeline.
- Received technology spotlight award in April 2021.
- Received Ottawa wireless department spotlight award in August 2021.

Jan2016 - Apr2020 **Doctoral Research**, *University of Waterloo*, Waterloo, Canada
- Developed a model-free data-driven method, using deep reinforcement learning, to compose and orchestrate abstract network services with time-varying traffic requirements onto the network substrate.
- Developed an online competitive algorithm for multicast services with mandatory and best-effort NFs. The algorithm is designed using a primal-dual based approach, and it offers generalized and alternative description to existing relevant works.
- Formulated an optimal joint traffic routing and NF placement for multicast services. Developed heuristic algorithm to decrease the complexity of the NP-hard problem.
- Three papers published in IEEE JSAC and IEEE Trans. Cognitive Networking and Comm.
- Link to thesis: http://hdl.handle.net/10012/15850

May2014 - Aug2015 **MASc Research**, *Simon Fraser University*, Vancouver, Canada
- Adopted two tractable mixture distributions, namely mixture of Gaussian and mixture of Gamma, to approximate various (composite) fading channels using the expectation-maximization and variational Bayes algorithms.
- Conducted performance analyses over various composite fading channels (using the mixture distributions) in several environments, such as cognitive radio networks, and impulsive noise environments.
- Results were published in seven conf/journal papers.
- Link to thesis: http://summit.sfu.ca/item/15696

Dec2013 - May2014 **Research Assistant**, *Etisalat British Telecom Innovation Centre*, Abu Dhabi, UAE
- Developed a data reduction pre-processing technique for large datasets to be used in machine learning classifiers. Several papers were published. Worked with by Paul. D. Yoo & Kin Poon.

Teaching Experience

Jan2018 - May2019 **Analog and Digital communications (ECE 318)**, *Teacher Assistant*, University of Waterloo
- Taught this subject for two terms.
- Duties included preparing the lab sessions, assisting/explaining to students theory and practical aspects, marking homeworks and projects, maintaining office hours to help students with understanding course material and lab projects.
- Took four courses related to this subject in my undergraduate and graduate studies.

Jan2018 - May2019 **Communication Networks (ECE 358)**, *Teacher Assistant*, University of Waterloo
- Duties included explaining computer networking concepts to students during the lab sessions, maitaining office hours to help students with various concepts about computer networks and with homeworks, and grading homeworks, exams, and lab projects.
- This course is intimately related to one of my current areas of research.

Jan2015 - May2015 **Introduction to Engineering Analysis (ENSC 180)**, *Teacher Assistant*, Simon Fraser University
- Topics included an introduction to Matlab and its use in engineering, and implementation, verification, and analysis of various engineering algorithms used in signal and image processing, robotics, communications engineering.
- Conducted office hours to help students with understanding the course material and their homework. I was also involved in the grading process for both homework and exams.
- Made good use of online teaching space (such as moodle and blackboard).

Jan2015 - May2015 **Linear Systems (ENSC 380)**, *Graduate Teacher Assistant*, Simon Fraser University
- Conducted office hours to help students with understanding the course material and their homework. I was also involved in the grading process for both homework and exams.

Jan2012 - Aug2013 **Tutor (Volunteering)**, Khalifa University, Abu Dhabi
- Gave several tutoring sessions for topics on Information Theory (CMME 304), Network Security (CMPE 495), Principles of Computer programming (CMPE 111), Digital logic Design (ELCE 230) at Khalifa University.

Jan2010 - May2012 **Science Communicator (part-time)**, *Intel Discovery Center*, Khalifa University, Abu Dhabi
- Delivered presentations and developed games to teach school students about various computing and communication concepts and technologies

Supervision

Sep 2021 - present Zaid Almahmoud, Deep Learning based Reconnaissance Techniques for Cyber Events, persuing Ph.D. at Birkbeck College, University of London. Co-supervision with Paul D. Yoo.

Jan 2021 - present Khalid AlHamdani, Ambient Backscatter Communications, persuing MSc. at Khalifa University. Co-supervision with Sami Muhaidat.

Jan 2020 - present Abubakar Sani Ali, Visible Light Communications, persuing Ph.D. at Khalifa University. Co-supervision with Sami Muhaidat.

Jan 2020 - present Esraa Mohammed Ghourab, Physical-Layer Techniques for the Next Generation Wireless Networks, persuing Ph.D. at Khalifa University. Co-supervision with Sami Muhaidat.

Patents

networking, distributed ML **O. Alhussein**, Architecture and method for network operations using distributed encoder-decoder structures, 2021, *filing process*.

networking, Bayesian DL **O. Alhussein**, and A. Akhavain, Traffic engineering framework guided by model uncertainty, 2021, *filing process*.

DRL, AI Trustworthiness **O. Alhussein**, and P. Ashwood-smith, Protection of DRL agents from theft with secret operational keys, 2021, *filing process*.

Publications

NFV, DRL **O. Alhussein**, and W. Zhuang, "Dynamic topology design of NFV-enabled services using deep reinforcement learning," *IEEE Trans. Cognitive Comm. Netw., accepted with minor revision (1st round), 2021.*

NOMA, full-duplex M. Li, S. Huang, L. Tian, **O. Alhussein** and S. Muhaidat, "Error rate performance of NOMA system with full-duplex cooperative relaying," Physical Comm., pp. 1-1, 2021.

trust management, IoT M. Ben-Yahya, **O. Alhussein**, and X. Shen, "Securing software-defined WSNs communication via trust management," IEEE Internet of Things J., pp. 1–1, 2021.

NFV, competitive analysis — **O. Alhussein**, and W. Zhuang, "Robust online composition, routing and NF placement for NFV-enabled services," IEEE J. Sel. Areas Commun., vol. 38, no. 6, pp. 1089–1101, 2020.

NFV, multicast routing — **O. Alhussein**, P. T. Do, J. Li, W. Shi, W. Zhuang, and X. Shen, "A Virtual network customization framework for multicast services in NFV-Enabled core networks," IEEE J. Sel. Areas Commun., vol. 38, no. 6, pp. 1025–1039, 2020.

ML, subsampling — **O. Alhussein**, P. D. Yoo, S. Muhaidat, J. Liang, "Efficient subsampling framework of very large datasets in machine learning," in Proc. IEEE CCECE, 2019, pp. 1-6.

wireless, fading, spectrum sensing — M. Li, **O. Alhussein**, P. Sofotasios, S. Muhaidat, P. D. Yoo, J. Liang, and A. Wang, "Censor-based cooperative multi-antenna spectrum sensing with imperfect reporting channels," IEEE Trans. Sustainable Comput., vol. 05, no. 01, pp. 48-60, 2019.

NFV, multicast routing — **O. Alhussein**, P. T. Do, J. Li, Q. Ye, W. Shi, W. Zhuang, X. Shen, X. Li, and J. Rao "Joint VNF placement and multicast traffic routing in 5G core networks," in Proc. IEEE GLOBECOM, 2018, pp. 1-6.

mixture Gaussian — M. Wahbah, **O. Alhussein**, et al., "Evaluation of parametric statistical models for wind speed probability density estimation," in IEEE Proc. EPEC, 2018, pp. 1-6.

SDN, space-air-ground — N. Zhang, S. Zhang, P. Yang, **O. Alhussein**, W. Zhuang, and X. Shen, "Software defined space-air-ground integrated vehicular networks: Challenges and solutions," IEEE Comm. Magazine, vol. 55, no. 7, pp. 101–109, 2017.

impulsive noise, generalized fading — **O. Alhussein**, I. Ahmed, J. Liang, S. Muhaidat. "Unified analysis of diversity reception in the presence of impulsive noise," IEEE Trans. Vehicul. Technol., vol. 66, no. 2, pp. 1408–1417, 2017.

cooperative spectrum sensing — A. Al Hammadi,**O. Alhussein**, P. C. Sofotasios, S. Muhaidat, M. Al- Qutayri, S. Al-Araji, G. K. Karagiannidis, and J. Liang, "Unified Analysis of cooperative spectrum sensing over composite and generalized fading channels," IEEE Trans. Vehicul. Techn., vol. 65, no. 9, pp. 6949–6961, 2016.

ML, cyber-security — O. Al-Jarrah, **O. Alhussein**, P. D. Yoo, S. Muhaidat, K. Taha, and K. Kim, "Data randomization and cluster-based partitioning for botnet intrusion detection," IEEE Tran. Cybern., vol. 46, no. 8, pp. 1796–1806, 2016.

wireless, fading model — B. Selim, **O. Alhussein**, S. Muhaidat, G. K. Karagiannidis, and J. Liang, "Modeling and analysis of wireless channels via the mixture of gaussian distribution," IEEE Trans. Vehicul. Techn., vol. 65, no. 10, pp. 8309–8321, 2016.

ML, botnet — R. Baiad, **O. Alhussein**, H. Otrok, and S. Muhaidat, "Novel cross layer detection schemes to detect blackhole attack against QoS-OLSR protocol in VANET," Vehicular Communin., vol. 5, pp. 9–17, 2016.

Mixture gamma, diversity analysis — **O. Alhussein**, A. Hammadi, P. C. Sofotasios, S. Muhaidat, J. Liang, M. Alqutayri, G. K. Karagiannidis, "Performance analysis of energy detection over mixture gamma based fading channels with diversity reception," in Proc. IEEE Wimob, 2015, pp. 399–405.

ML — F. Adly, **O. Alhussein**, P. D. Yoo, S. Muhaidat, and Y. Al-Hammadi, "Simplified subspaced regression network for identification of defect patterns in semiconductor wafer maps," IEEE Trans. Ind. Informat., vol. 11, no. 6, pp. 1267–1276, 2015.

mixture Gaussian model — **O. Alhussein**, B. Selim, T. Assaf, S. Muhaidat, G. K. Karagiannidis, and J. Liang, "A generalized mixture of gaussians for fading channels," In Proc. IEEE VTC, 2015, pp. 1–6.

spectrum sensing, fading — B. Selim, **O. Alhussein**, G. K. Karagiannidis, and S. Muhaidat, "Optimal cooperative spectrum sensing over composite fading channels," in Proc. IEEE ICC, 2015, pp. 520–525.

EM, fading — **O. Alhussein**, S. Muhaidat, J. Liang, and P. D. Yoo, "A unified approach for representing wireless channels using EM-based finite mixture of gamma distributions," in Proc. Globecom Workshops, 2014, pp. 1008–1013.

OFDM, SDR — **O. Alhussein**, R. Mahmoud, K. Eledlebi, and Z. Sead, "Spectrum sensing techniques for OFDM-based cognitive radio networks," in Terena Netw. Conf., 2013, *Indexed poster*.

ML — K. Alromaithi, **O. Alhussein**, and P. D. Yoo, "An intelligent system for protein structure prediction," in Undergraduate Research Conf. Applied Comput., Zayed University, 2012, *Poster*.

S. Azzeh, **O. Alhussain**, and S. A. Abusamra, "A mathematical model to decrease obesity in the UAE," in Proc. ASME IMECE, 2011, pp. 385-390.

Technical Skills

Sim. & Math — Tensorflow, Matlab, Mathematica, R, Weka

Programming	Python, C++, Git
Networking	Mininet, Wireshark, NMAP, OpenFlow

Pedagogical Training

May2021 - Sep2021	Passed an online course from the University of Hong Kong on the fundamentals of university teaching.
2019-2020	Attended six seminars at the University of Waterloo that covered various topics: (a) teaching methods, (b) effective lesson plans, (c) classroom delivery skills, (d) student's beliefs about learning, and (e) providing quality feedback.

Service

2013-present	Regular Reviewer for IEEE Commun. Lett., IEEE Tran. Vehicular Technologies, IEEE Tran. Cognitive Commununications and Networking, Proc. IEEE Globecom, and other journals/conferences
2021-present	Technical program committee (TPC) member for Proc. IEEE VTC
2018-present	Technical program committee (TPC) member for Proc. IEEE CommNet
2010–2012	Vice Chair, IEEE Student Chapter, Khalifa University
2010–2011	Engineering Section Editor, Student Voice Newsletter, Khalifa University

Honors and Awards

Aug2021	Wireless Department Spotlight Award at Huawei Technologies Canada, Ottawa
Apr2021	Director Technology Spotlight Award at Huawei Technologies Canada, Ottawa
Sep2019	University of Waterloo Graduate Scholarship ($1500)
Sep2019	Xuemin Shen Graduate Scholarship in communications ($1000)
May2019	University of Waterloo Graduate Scholarship ($1500)
Jan2016	Faculty of Engineering Graduate Scholarship, University of Waterloo ($1500)
Sep2015	Four-year Graduate Fellowship and nomination for Vanier (which was not claimed), Simon Fraser University ($200,000)
Jan2014 - Aug2015	Graduate fellowship, Simon Fraser University ($6250)
Sep2008 - Aug2013	Five-year Undergraduate Scholarship, Khalifa University ($172,822).
May2012	Won First Place at the ASME rapid design challenge, District J. Development Conference at the Lebanese American University, Lebanon.
2009-2011	Represented Khalifa University at gulf/national programming contest (NPC2009, NPC2010, GPC2011).
2010–2010	Won First Place at University Programming Contest, Khalifa University ($\tilde{\$}200$).
2010–2010	Won Second Place at the Engineering Design Competition, IEEE-UAE Student Day ($\tilde{\$}200$).

Other Interests

Swimming and Free-diving (Licensed AIDA-2, personal record: 3m45s static apnea).

Traveling (mostly occasional weekend escapades, and event travels).